By Linda Meyers

A Review of RO

Instrumenting reverse osmosis (RO) systems for maximum efficiency and minimum maintenance

Although the Earth's surface is covered with 70% water, less than 3% is usable freshwater. With that in mind, an increasingly significant application for RO membrane technology is the desalination of seawater, river or brackish water to produce potable water. In larger systems, multiple trains for RO membranes are utilized to obtain large volumes of product water. Additional applications range from purified water treatment for semiconductor and other industrial processes to the use of smaller membranes for the removal of bacteria and viruses in home water systems.

The filtered stream is the desired product water called the permeate; the waste stream is the concentrate, or reject. The concentrate may be disposed of or evaporated into a solid waste or purified salt. This article will examine the specific instrumentation requirements for RO membrane systems, many of which also apply to other water treatment technologies such as deionization or media filtration.

Typical Problems & Solutions

RO systems are subject to a variety of problems that can affect efficient operation and, if left untreated, damage or destroy the spiral-wound membranes that are the center of the RO process. These problems include scaling, fouling and chemical attack.

Membrane scaling is caused by carbonates, sulfates or silica in the feedwater. It is indicated by a reduction in normalized permeate flow. Membrane fouling is most often attributed to silt, clay, upstream filter media and bacteria contained in the feedwater and results in decreasing product output. Chemical attack is caused by oxidizing agents such as chlorine, bromine, hydrogen peroxide, iodine and ozone that can actually destroy thin-film composite membranes. Chemical attack causes an increase in normalized permeate flow but a reduction in product quality as the damaged membranes pass water and dissolved minerals.

Properly instrumenting an RO system can identify and control these types of problems before they cause degradation of system output quantity and quality and potential membrane damage. The monitoring of important system parameters to identify possible problems early on results in maximum system efficiency and minimum system maintenance. These parameters include conductivity, flow, pH, oxidation reduction potential (ORP), pressure and temperature.

Conductivity measurement is the most critical parameter in an RO system. Conductivity measurements provide an indication of system efficiency and can be used to trigger an alarm condition when product quality or percent rejection decreases indicate a problem. A number of conductivity controllers specifically target the RO industry. These units, such as GF Piping Systems' Signet 3-8900 conductivity controller, provide dual-sensor inputs for both feed and permeate measurement and automatically calculate and control the percent rejection ratio. In some instances, reject water conductivity is monitored to record the total dissolved solids level of the stream diverted to waste.

Using Flow Sensors

The use of flow sensors in the feed and product water to monitor the flow rate and the total amount of water processed through the system is also important. The permeate flow rate can be used as an indication of system health and efficiency. A decreasing permeate flow is indicative of membrane scaling or fouling, while an increased permeate flow may suggest possible chemical attack. Monitoring the total flow of feedwater processed through the system can also be used to track maintenance schedules for backwatering and cleaning of the membranes. Some municipalities require the monitoring of total volume of brackish water sent to waste.

Another useful parameter for measuring system health and efficiency is pH level. Because high pH and calcium levels can cause membrane scaling, a pH controller should be used to monitor incoming feedwater and adjust the pH levels accordingly. Incoming pH control minimizes potentially damaging pH excursions and reduces or eliminates the need for pH control on the reject stream going to waste.

ORP monitoring of the feedwater using ORP instrumentation assures that the dechlorination process is effective. High levels of chlorine and other oxidants negatively affect membrane efficiency and life span. ORP control reduces or eliminates the danger of membrane damage from these chemicals.

Pressure sensors are used to monitor pressure drops across the membranes. Increased pressure drop is indicative of membrane scaling or fouling and warns of reduced system efficiency.

Feedwater temperature should also be monitored. Influent water temperature has a direct effect on the rejection rate of the membrane. Lower temperatures reduce the ability of the membrane to reject mineral salt. At lower temperatures, increased pressure is required to maintain output quantity.

Using comprehensive and reliable instrumentation in RO systems to measure the critical parameters of conductivity, flow rate, pH, ORP, pressure and temperature will result in substantial savings in treatment chemicals, filter replacements and membrane cleaning and replacement costs. Proper measurement can also increase system efficiency and reliability. MT

Linda Meyers is product manager for GF Piping Systems' George Fischer Signet, LLC, facility. Meyers can be reached at 626.571.2770 or by e-mail at linda.meyers@georgfischer.com.

For more information, write in 1108 on this issue's Reader Service Card.

LEARN MORE

For additional articles on this topic, visit: www.wwdmag.com/lm.cfm/mt030808